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-USSR-







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# PLASTIC CLOSURE OF A DURA MATER DEFECT BY A POLYVINYL LAMELLA

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The problems involved in the use of plastics for defects of the dura mater are still unsolved.

Progress in the chemical industry offers an opportunity for perfecting the application of plastics to the replacement of sections of the dura mater. Such plastics must meet the following requirements: the material must be well adapted to grafting; it must be impermeable to the cerebrospinal fluid; its composition must remain unchanged for long periods of time; it must not shrink; and, most important, it must have no toxic properties, nor can it be an irritant to the brain.

Polyvinyl lamellas meet all of the indicated requirements.

Polyvinyl alcohol has found wide adaptation in various aspects of plastic surgery. In 1957, T. T. Dautova (Institute of Surgery imeni A. V. Vishnevskogo, AMN SSSR /USSR Academy of Medical Sciences/) used polyvinyl alcohol in plastics of the alimentary canal, and she came to the conclusion that the fibrous membrane which forms around the inserted prosthesis is a durable wall of the newly growing alimentary canal. On the 40th day after surgery, the fibrous membrane was 3 to 4 mm in thickness; its inner surface was shiny, partially covered by a flat epithelium which grew from the edges of the alimentary canal. This material was used in a clinic during surgery on cancer of the upper and median sections of the alimentary tract.

In that same year, Ayers, Cincotti and others used prostheses of polyvinyl alcohol in experimental replacements of arteries; this was used instead of the earlier lyophized homotransplants.

In 1958 Pesek and Keeley demonstrated that a lamella from a polyvinyl sponge, when sewed into an experimental diaphragm defect, is overgrown by a fibrous membrane, and that after six to twelve months, it is hardly distinguishable from normal diaphragm tissue.

A polyvinyl lamella is soft, elastic, has a simple structure, does not dissolve in organic fluids, and is highly resistant to breakage.

The purpose of our report is to analyze the results in neurosurgery of a plastic closure of defects in the dura mater with a polyvinyl lamella.

To accomplish this, clinical observations were conducted on patients after plastic surgery of the dura mater; biopsy specimens, obtained from repeated operations and from autopsies, were examined.

The plastic approach, using polyvinyl lamellas on the dura mater, was employed on 148 patients. Of these, 143 patients had been operated on for brain tumor, and 5 patients for tumor of the spinal cord. For histological examinations, we used pieces of polyvinyl plastic which had been sewn into the edge of the dura mater of 15 patients undergoing repeated surgery; specimens were also taken from those patients who had died after surgery. The length of time which the plastic had been in the organism were as follows: 4 days, 1 case; 8-14 days, 3 cases; 1-2 months, 3 cases; 6 months, 2 cases; 9 months, 3 cases; 1 year and 1 month, 1 case; and 1 year and 10 months, 2 cases.

On the fourth day after plastic surgery, the patient's polyvinyl lamella is surrounded by connective tissue proliferations from the sides and the top. The following may be seen: strands of young connective tissue, containing newly formed vessels; in the pores there are giant cells of the foreign body; leucocytes and brain matter debris. The under surface of the lamella, touching on the soft brain, remains free.

By the 14th day, the connective tissue elements surround the polyvinyl lamella from all sides, and enter into its pores. In the pores closer to the surface, the connective tissue fibers become more dense, while in the deeper pores, they are loosely packed. Giant cells of the foreign body lie between the new connective tissue and the pore surface. There are many neutrophils and leucocytes, as well as occasional epithelial cells. On the inner surface of the lamella, the connective tissue membrane is as yet absent.

After a month, no gross adhesions can be observed between the polyvinyl lamella, encapsulated by connective tissue, and the brain. The outer part of the connective tissue capsule includes elements of subcutaneous cells. Tissue strands, growing on the surface of the lamella, have become denser. Many vessels are observed in this layer. The inner surface of the lamella is covered by a thin, newly formed membrane of connective tissue. The pores show a large quantity of foreign body giant cells.

After two months, the lamella touching that part of the brain tissue which had formerly been softened, is now bordered by a very thin layer of connective tissue which merges with the gliomesodermal scar just beneath it. Foreign body giant cells occur in the pores. Those aggregates of connective tissue which enter into the lamella from the top, are coarse compared to those which come from the under

surface.

In another specimen, the connective tissue capsule which covers the under surface of the lamella is, at the edges of the dura mater, composed of connective tissue clumps stretched out parallel and merging with the soft membrane. A thickening occurs in this area. (fig. 1).

After six months, fragments of the polyvinyl lamella are seen in the specimen. Connective tissue fibers, enveloping the lamella from both sides, stand out clearly. And here, the clumps of connective tissue fibers in the pores are not as dense as in those areas which adjoin the surface of the lamella. The giant cells take on a somewhat elongated form. Vessel walls are collagenized.

In the nine-month-old specimen, the polyvinyl lamella is virtually unchanged. It is enveloped by a connective tissue membrane. There are no connective tissue elements in the pores, although in this case, the lamella taken was more dense (fig. 2).

The picture remains the same, on the whole, in specimens of one year and one month, and one year and ten months' duration. In the preparations made of the one year and ten months' duration, the specimen tissue was taken from the area where the polyvinyl lamella joined the dura mater. The lamella is fragmented by strands of connective tissue. The layers closer to the surface have parallel clumps of fibers; in other areas, the clumps are much denser, and have a wave-like form, with a limited number of elongated nuclei. In the pores, there are moist strands of connective tissue with round nuclei. Giant cells of the foreign body lie between the surface of the pores and the loosely packed clumps of fibers. In individual areas, these cells lie within the loosely packed clumps of connective tissue fibers. In that area where there is an interruption of the polyvinyl lamella, the connective tissue fibers penetrate into the defect, and merge with the gliomesodermal scar. The softened brain matter is seen clearly, as well as the traversing clumps of connective tissue fibers of the capsule's upper layers. The outer surface of the polyvinyl lamella is covered by connective tissue fibers which are feebly expressed in the central part of the inner surface. In the strands of connective tissue, vessels with collagenized walls are seen. That area of tissue which lies under the lamella has a smooth surface. The connective tissue capsule and the brain surface are separated by a layer of loosely packed young connective tissue elements.

This histological research demonstrates that: 1) a polyvinyl lamella retains its consistency and structure for prolonged periods of time; 2) within a short time, it is enveloped by connective tissue elements, and it grows into the defective area of the dura mater very well; 3) when the lamella has large pores, it is quickly penetrated by strands of connective tissue (with a denser lamella, connective tissue penetrates hardly at all, or else only through the top pores. Moreover, the lamella by an interlacing of fragile connective tissue, separates the rapidly forming stage of the coarse peiosteal scar

from the later stage when the cerebral membrane scar forms.

In repeated surgery, the polyvinyl band with a duration of ten days to one year and ten months, was unchanged in one case, and could easily be separated from the cerebral tissue. In another case (six months), the lamella resembled a connective tissue membrane, had a smooth surface, and in places had formed adhesions to the cerebral membrane changed by scar formation. In the rest of the cases, the lamella seemed outwardly unchanged, but at the points of contact with cerebral tissue, fragile adhesions were noted at the organic areas; these adhesions separated easily when the lamella was lifted up.

During the post-operative period, neither the general condition of the patient, nor the blood or lacunar liquid composition showed any changes which could be attributed to the use of a polyvinyl lamella.

The lack of complications in the post-operative period, the long-term structural stability of the polyvinyl lamella inserted into the wound, the lamella's ability to fix well into the dura mater defect, as well as the absence of coarse adhesions between the lamella capsule and the brain matter -- all these indicate that a polyvinyl lamella is a desirable alloplastic material. It protects the brain adequately, isolates lacunar spaces, and prevents merging of the coarse surface scar with the underlying gliomesodermal scar.

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